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Chromosomal multiformity in *Eligmodontia* (Muridae, Sigmodontinae), and verification of the status of *E. morgani*

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Abstract

Studied standard karyotypes of *Eligmodontia puerulus* from Bolivia (6 males, 3 females), and standard and C-banded karyotypes of *Eligmodontia* sp. from Patagonian Argentina (3 males) and Chile (6 males). The former materials amplify the known range for the 2n = 50 cytotype of *E. puerulus*. The latter materials (2n = 32–33) are from localities in close proximity with the type locality of *E. morgani*, and we conclude that these are conspecific. Hence we propose that three species of *Eligmodontia* exist: (1) *E. puerulus* (2n = 50, FN = 48); (2) *E. typus* (2n = 43–44, FN = 44); and (3) *E. morgani* (2n = 32–33, FN = 32). Their distribution is given in Fig. 1.

Introduction

The unstable taxonomic history of the genus *Eligmodontia* Cuvier, 1837 (Muridae, Sigmodontinae) has been reviewed by Tate (1932) and Hershkovitz (1962). *Eligmodontia* has been considered monotypic since Hershkovitz subsumed earlier names under two subspecies, *E. typus* Cuvier, 1837, and *E. typus puerulus* Philippi, 1896. This genus occupies a range of habitats from the Altiplano of Peru and Bolivia to the pampa of Magallanes (Cabrera and Yepes 1940; Mares 1980; Mares et al. 1981; Osgood 1943; Pearson 1951; Pearson et al. 1987), and appears to be the most desert-adapted sigmodontine (Mares 1975, 1977). A recent report (Ortells et al. 1989) documented significant genetic variability in *Eligmodontia* and proposed elevation of the two subspecies of Hershkovitz (1962) to specific status. These species are characterized by 2N = 43–44, FN = 44 (*E. typus*), and 2N = 50, FN = 48 *(E. puerulus).* Ortells et al. (1989) also reported a 2N = 32–33, FN = 32 karyotype from Neuquen Province, Argentina, and suggested that this may represent a third species, but they concluded that data were insufficient to resolve this taxonomic problem. Here we report additional specimens with the 2N = 32, FN = 32 karyotype, extending the distribution of this form to near the type locality of *E. morgani* Allen, 1901, and supporting the specific recognition of *E. morgani.* Additionally, we document the chromosomal complement of *E. puerulus* in Bolivia.

Materials and methods

Chromosomal preparations were obtained from bone marrow following conventional colchicine-hypotonic technique (Baker et al. 1981) as modified by Lee and Elder (1980) for Argentinean and Chilean specimens, and with Velban (Anderson et al. 1987) for Bolivian specimens. C-bands were induced by the barium hydroxide technique (Sumner 1971). Karyotypes were prepared from selected materials, and a minimum of 10 metaphase spreads were counted for each specimen. Nomenclature

for chromosome morphology and autosomal fundamental number (FN) follow Patton (1967). Chromosomes were arranged and numbered sequentially in order of decreasing size, with single-armed elements preceding biarmed elements.

We analyzed the chromosomes of 18 specimens from five localities in Argentina, Bolivia, and Chile (Fig. 1). These specimens are housed in the Field Museum of Natural History (FMNH), Museum of Southwestern Biology (MSB), and Colección de Mamíferos, Instituto de Ecología y Evolución, Universidad Austral de Chile (IEEUACH). Collection localities are given below and in Fig. 1.

Fig. 1. Map showing locations mentioned in the text. Diploid numbers for *Eligmodontia* spp. are indicated for sites where this information is available. The type locality for *E. morgani* Allen, 1901 is denoted by the star at Arroyo Else

Argentina: Rio Negro Province, Bariloche, 5 km SE Estación Perito Moreno ("Cerro Microondas" of Pearson 1987), 1317 m, ca. 41° S 71° W (3 males, IEEUACH 1738, 1739, 1740).

Bolivia: Oruro Department; 37 km SE Oruro, ca. 3850 m, ca. 18° 21′ S 67° 32′ W (1 male, MSB NK 14518); Estancia Agua Rica, 22 km S Sajama, 3850 m, 18° 20′ S 68° 36′ W (2 males, MSB NK 14526, NK 14544); Rio Barros, 5 km W, 1 km N Pomata Ayte, 3850 m, 18° 19′ S 67° 59′ W (1 male, MSB 14551, 3 females, MSB NK 14552, NK 14554, NK 14560); Potosí Department; 2 km E ENDE camp, Laguna Colorada, 4280 m, 22° 10′ S 67° 47′ W (2 males, MSB NK 14586, NK 14589).

Chile: Lago General Carrera Province, 2 km S Chile Chico, 350 m, 46° 33′ S 70° 56′ W (6 males, FMNH/IEEUACH 133053/3657, 133056/3660, 133059/3663, 133060/3664, 133061/3665, 133063/3667).

Results

The chromosome complement of *Eligmodontia* from all Bolivian sites (2n = 50, FN = 48) is identical to that described by Pearson and Patton (1976), and consists of 25 pairs of acrocentric chromosomes (Fig. 2). Four or five of these are large-sized chromosomes, followed by 20 or 21 medium to small pairs. The secondary constrictions reported by Pearson and Patton (1976) for chromosome pair 6 were not clearly visible in our samples from Bolivia. The sex chromosomes consist of a medium-sized acrocentric X and a small submetacentric Y.

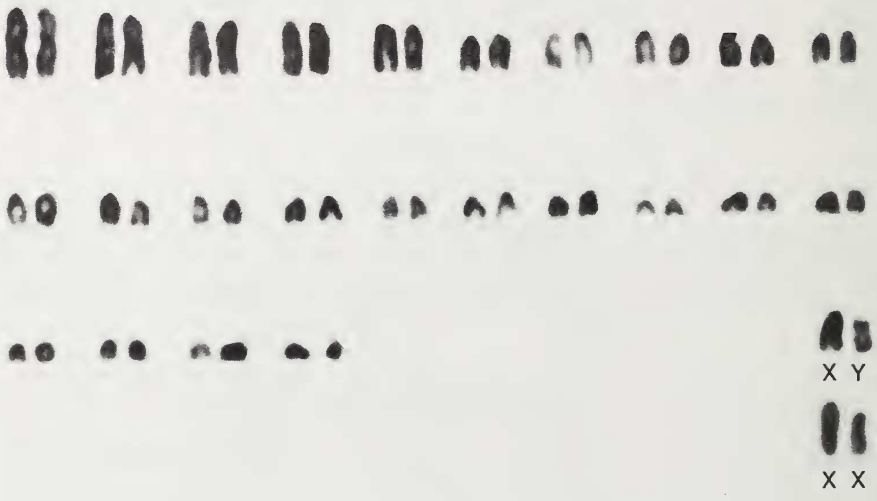

Fig. 2. Standard Giemsa stained karyotype of *Eligmodontia puerulus*. Given is the karyotype for a male from 37 km SW Oruro, and the sex chromosomes of a female from Pomata Ayte

The chromosomal complement of *Eligmodontia* near Chile Chico and at Bariloche (2N = 32, FN = 32) is formed by 14 pairs of acrocentric autosomes (six large; eight medium-sized to small) and one pair of medium-sized metacentric autosomes (Fig. 3). Because we ordered chromosomes by structure and then by size our chromosome pair 15 corresponds to pair number 7 of Ortells et al. (1989), and our numbers 7 through 14 correspond to their numbers 8 through 15. The sex chromosomes consist of a medium-sized acrocentric X and a small subtelocentric Y.

The C-banding pattern of the southern form (Fig. 4) is characterized by small amounts of centromeric heterochromatin, except for pairs 11–15, which exhibit conspicuous blocks. Pair 2 has a telomeric block of heterochromatin, which is heteromorphic. The Y chromosome appears totally heterochromatic, while the X does not exhibit a clear C-banding pattern. The lack of a clear pattern in the latter may have resulted from technical problems during preparation.

Discussion

Eligmodontia typus was described from materials collected in "Buenos Aires", Argentina (Cuvier 1837), although the specific locality was unclear. D'Orbigny and Gervais (1847) later designated the type locality as Corrientes Province. It is doubtful, however, that

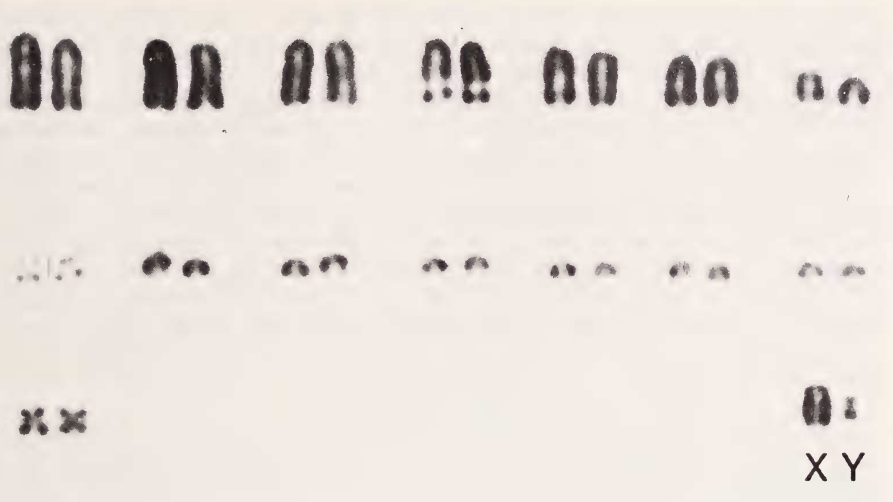

Fig. 3. Standard Giemsa stained karyotope of *Eligmodontia* sp. from Chile Chico, XI Region, Chile, 2n = 32, FN = 32

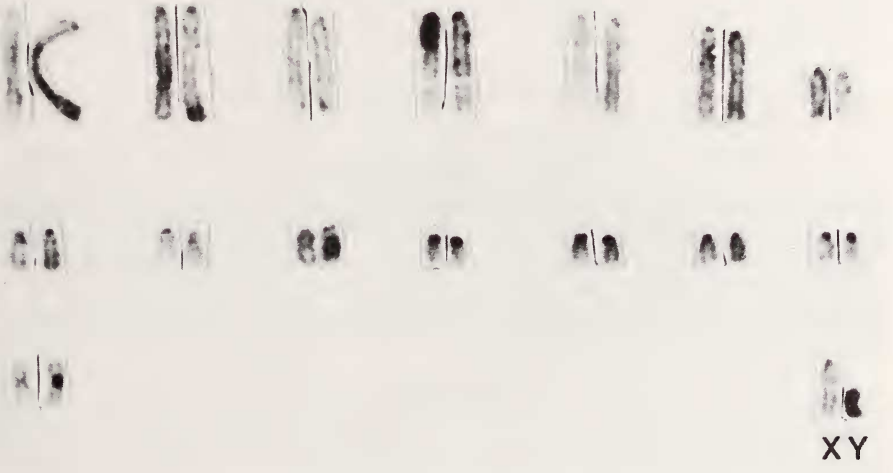

Fig. 4. C-banded karyotype of *Eligmodontia* sp. from Chile Chico, XI Region, Chile, 2n = 32, FN = 32

Eligmodontia has ever naturally occurred in Corrientes Province (Hershkovitz 1962), and the provenance of the type specimen of *E. typus* remains uncertain (Hershkovitz 1962; see also J. C. Contreras, in Ortells et al. 1989). Philippi (1896) later described *Hesperomys* (= *Eligmodontia*) *puerulus* from San Pedro de Atacama, Antofagasta, Chile.

Although it has generally been agreed that at least two groups exist within the genus, their taxonomic status has remained unresolved. *Eligmodontia puerulus* and *E. typus* were recognized by Osgood (1943, 1947) and Mann (1945), but were relegated to subspecific status by Hershkovitz (1962). Pearson and Patton (1976) accepted Hershkovitz's (1962) arrangement, whereas Reise (1973) and Corbet and Hill (1980) followed Osgood

(1943). Honacki et al. (1982: 410) regarded *Eligmodontia* as monotypic but one reviewer (D. F. Williams) noted that "*puerulus* is probably a separate species". The latter hypothesis was supported by the karyotypic multiformity documented by Ortells et al. (1989), who recommended specific distinction for the two chromosomal forms. These were a 2N = 50, FN = 48 karyotype from Peruvian specimens (Pearson and Patton 1976), and a 2N = 44, FN = 44 karyotype from southern Argentina (Ortells et al. 1989).

Pearson and Patton's (1976) Peruvian specimens were assigned to *E. typus* (Ortells et al. 1989), and implicitly to *E. typus puerulus*. The 2N = 44, FN = 44 cytotype (Ortells et al. 1989) was collected near the type locality of *E. elegans*, which generally has been considered a junior synonym of *E. typus* (references in Ortells et al. 1989). Because of this fact, and the uncertainty of the type locality of *E. typus*, Ortells et al. (1989) applied the name *E. typus* to this karyotype, thereby requiring a reconsideration of the appropriate name for the Peruvian cytotype. The most appropriate available name was *E. puerulus* from northern Chile (Fig. 1; Philippi 1896), acceptance of which effectively elevated *E. typus puerulus* and *E. typus typus* (Hershkovitz 1962) to specific status. Our collections from Bolivia suggest that the 2N = 50, FN = 48 karyotype is continuous with northern Chilean populations of *Eligmodontia*, concurring with Ortells et al.'s (1989) interpretations.

Ortells et al. (1989) also presented a 2N = 32–33, FN = 32 karyotype from the precordilleran steppe of Los Lagos, Neuquen Province, Argentina (Fig. 1), although they considered the systematic and nomenclatural status of this form to be unresolvable with the state of knowledge available to them. Ortells et al. (1989: 137) concluded that the extensive polymorphism and multiformity they encountered indicated that "each of these karyotypes belongs to a different species". However, after reviewing nomenclatural considerations and the geographical arrangement of the southern karyotypic forms, they stated that "it seems that a single species of *Eligmodontia* inhabits the south and the east central Patagonia" (page 138), and they did not assign any specific name to the 2N = 32–33 form collected at Los Lagos.

The present paper documents more thoroughly the chromosomal complement of specimens in the Andean precordillera of southern South America, and demonstrates a consistent pattern in both morphology and banding patterns of these populations, allowing us to extend the results of Ortells et al. (1989). Three chromosomal forms characterize *Eligmodontia* and these are geographically consistent with the proposal that these represent independent lineages with separate evolutionary trajectories. The magnitude of the chromosomal differences between the two southern forms is substantial, indicating that very likely they are reproductively isolated.

This leaves the question of what name to apply to the 2N = 32–33 chromosomal form. Ortells et al. (1989) noted the availability of *E. morgani*, collected at Arroyo Aike, NW Santa Cruz Province, Argentina, and roughly 400 km S Los Lagos, but they expressed concern that their collections at Pampa de Salamanca (2N = 44) were closer to the type locality of *E. morgani* than was their only location for the 2N = 32 karyotype (Los Lagos district, Neuquen Province). Our specimens considerably extend the distribution of the 2N = 32 form southward and suggest that this cytotype may occur throughout western Patagonia. The type locality of *E. morgani* was originally given as "Arroyo Else, Patagonia" (Allen 1901: 409), but it was noted that the description was "based on a large series of specimens collected at or near Cape Fairweather" (Allen 1901: 410), which is roughly 500 km farther south. As noted later by both Osgood (1943) and Hershkovitz (1962), however, the locality on the holotype was "Basaltic Cañons', 50 miles southeast of Lake Buenos Aires, Patagonia" (see Allen 1905: 53, and Hershkovitz 1962: 155). This places the type locality for *E. morgani* within 70 km of our collection sites. In this context, it is interesting to note Osgood's (1943: 199) contention that "specimens from western Rio Negro [Province] seem to indicate that *morgani* may have a northward distribution in

that region". This was accepted by Mann (1978), who referred to *E. typus morgani*, and gave its range as "from Rio Negro to the Strait of Magellan and extreme southern Chile" (1978: 192; translated from Spanish). Finally, although a morphometric investigation has not been undertaken, it should be noted that skulls and skins of specimens from the original collection at Arroyo Else do not visibly differ from those reported here as *E. morgani*.

The specimens reported here help to elucidate the geographic relations of Patagonian cytotypes. Our specimens place the 2N = 32 chromosomal form closer to the type locality of *Eligmodontia morgani* than heretofore documented, and we assume that the distribution of these is continuous. The distribution of this form is western Patagonia in Neuquen, Rio Negro, and Santa Cruz Provinces. Our new specimens alleviate the concerns expressed by Ortells et al. (1989) that *Eligmodontia morgani* may be a junior synonym of *typus*, and we recommend specific recognition of *E. morgani*.

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Zusammenfassung

Chromosomale Vielfalt bei Eligmodontia (Muridae, Sigmodontinae) und Bestätigung des Status von E. morgani

Untersucht wurden Standard-Karyotypen von *Eligmodontia puerulus* aus Bolivien (6 Männchen, 3 Weibchen) und Standard- und C-Banden-Karyotypen von *Eligmodontia* sp. aus dem argentinischen (3 Männchen) und dem chilenischen Teil (6 Männchen) Patagoniens. Durch ersteres Material wird die bekannte Verbreitung des 2N = 50 Zytotyps von *E. puerulus* erweitert. Das letztere Material (2N = 32–33) stammt aus nächster Nähe der Typus-Lokalität von *E. morgani*, und wir vermuten, daß es sich um die gleiche Art handelt. Demnach existieren offenbar drei *Eligmodontia*-Arten: 1. *E. puerulus* (2N = 50, FN = 48); 2. *E. typus* (2N = 43–44, FN = 44); und 3. *E. morgani* (2N = 32–33, FN = 32). Die Verbreitung geht aus Abb. 1 hervor.

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